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Battery Monitoring Unit Using SCADA

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Abstract: - *Battery* ***Management System (BMS) means different things to different people. To some it is simply battery monitoring, keeping a check on the key operational parameters during charging and discharging such as voltages and currents and the battery internal and ambient temperature. The monitoring circuits would normally provide inputs to protection device which would generate alarms or disconnects the battery from the load or charger should any of the parameters becomes out of limit. For the power or plant engineer responsible for standby power, whose battery is the last line of defence against a power blackout or a telecommunications network outage. BMS means Battery Management System; such systems encompass not only the monitoring and protection of the battery but also methods for keeping it ready to deliver full power when called upon and methods for prolonging its life. For the automotive engineer the battery management system is a component of a much more complex fast acting. Energy management system must interface with other on board system such as engine management, climate controls, and communications and safety systems. SCADA technology is best applied to processes that are spread over long areas are relatively simple to control and monitor and require frequent regular or immediate intervention***.

Keywords-Battery Management System (BMS)

I. Introduction

SCADA (Supervisory Control and Data Acquisition) system allows an operator to make set point changes on distant, process controllers, to open or close valves, or switches, to monitor alarms and to gather measurement information from a location central to widely distributed processes such as an oil or gas field ,pipeline system or hydroelectric generating complex. When the dimensions of the process becomes very large hundred or even thousands of kilometres from one end to the others, one can appreciate the benefits of SCADA ,offers in terms of reducing the cost of routine visits to monitor facility operation

1.1. Elements of SCADA System

Figure 1.1 shows the major components of SCADA system. At the centre is the operation, which accesses the system, by means of an operator interface device which is sometimes called, "an operator console". The operator console functions as the operator's window into the process.
It consist of a video display unit (VDU)that displays real time data about the process and a keyboard for inputting the operators commands or messages back to the process. Other cursor positioning device, such as a trackball mouse or touch screen may be used. If the system is very simple it may be sufficient to have a set of annunciate window that mimic the condition of the remote process. Often an audible signal will be included.

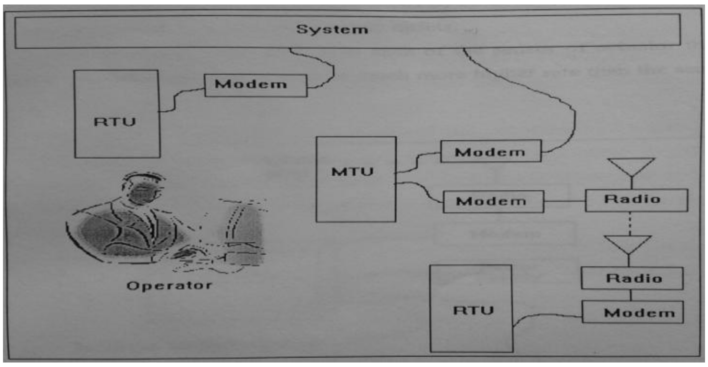

Figure.1.Major Components of SCADA System

For very basic system, a set of simple electrical switches may be sufficient. The operator interfaces with the master terminal unit (MTU) which is the system controller. Some industries use the term,' host computer", instead of MTU. The MTU in modern SCADA systems is always based on a computer. It can monitor and control the field even when the operator is not present. For example, it may be scheduled to request and update from each remote terminal unit (RTU), in every six minutes.

2. Battery Health Check Unit

2.1. Necessity of Battery Monitoring Unit

For the automotive engineer the battery management system is a component of a much more complex fast acting. Energy management system must interface with other on board system such as engine management, climate controls, and communications and safety systems. SCADA technology is best applied to processes that are spread over long areas are relatively simple to control and monitor and require frequent regular or immediate intervention.

For the power or plant engineer responsible for standby power, whose battery is the last line of defence against a power blackout or a telecommunications network outage.BMS means Battery Management System; such systems encompass not only the monitoring and protection of the battery but also methods for keeping it ready to deliver full power when called upon and methods for prolonging its life.

Battery Management System (BMS) means different things to different people. To some it is simply battery monitoring, keeping a check on the key operational parameters during charging and discharging such as voltages and currents and the battery internal and ambient temperature. The monitoring circuits would normally provide inputs to protection device which would generate alarms or disconnects the battery from the load or charger should any of the parameters becomes out of limit.
There are many verities of BMS

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2.1.1. BMS Building Blocks

There are three main objectives common to all Battery Management Systems.

- Protect the cells or the battery from damage.
- Prolong the life of the battery.
- Maintain the battery in a state in which it can fulfill the functional requirements of the application for which it was specified.

To achieve these objectives the BMS may incorporate one or more of the following functions.

i) Cell protection
ii) Charge control
iii) Demand management
iv) State of Charge(SOC)determination
v) State of Health(SOH)determination
vi) Cell balancing
vii) History(log book function)
viii) Communication

2.1.2. Power Plant BMS

The battery management requirements are quite different for standby and emergency power installations. Batteries may be inactive for long periods topped up by a trickle charge from time to time, or as in telecommunication installations must be kept on float charge to keep them fully charged at all times. By their nature, such installations must be available for use at all times. All essential responsibility of managing such installations is to know the status of the battery and whether it can be relied upon to support its load during an outage. For this it is vital to know the SOH & the SOC of the battery.

In the case of lead acid batteries the SOC of individual cells can be determined by using a hydrometer to measure the specific gravity of the electrolyte in the cells. Traditionally the only way of determining the SOH was by discharge testing, that is ,by completely discharging the battery and measuring its output. Such testing is very inconvenient. For a large installation it could take eight hours to discharge the battery and another three days to recharge it. During this time the installation would be without emergency power unless a backup battery was provided.

The modern way to measure the SOH of a battery is by impedance testing or by conductance testing. It has been found that a cell's impedance has an inverse correlation with the SOC and the conductance being the reciprocal of the impedance has a direct correlation with the SOH of the cell. Both of these tests can be carried out without discharging the battery, but better still the monitoring device can remain in place providing a permanent on line measurement. This allows the plant engineer to have an up to date assessment of the battery condition, so that any deterioration in cell performance can be detected and appropriate maintenance actions can be planned.

3. Battery Management Unit

This research is the requirement of power plant ,based on high frequency switch mode techniques, using switching frequencies of 20KHz and above for the use in Indian telecom network.

3.1. Technical Requirements

SMPS is intended to be used in auto float-cum charge mode as a regulatory DC power source. Switching frequencies of these power plants shall be 20 KHz and above. The system shall be RS485 compatible. It shall be feasible to set any monitoring control parameter from a remote site through RS485.All the information regarding control and monitoring of power plant data are accessible on demand from the remote site. The exchange of information and protocol format are as decided. The DSCA shall be provided for the ultimate capacity of the power plant. However, it shall be provided either in the first rack or in a separate rack. The DSCA, in addition to control, monitoring and alarms shall provide for the following:-

I) Termination for the batteries
II) Termination for the exchange load
III) Interconnecting arrangement for power equipment
IV) Battery switching arrangement (connection to/isolation from)
V) Termination for AC input to the rack shall be finger touch Proof, flame retardant insulated.
VI) Termination of AC & DC to FR/FC modules.
VII) Circuit breakers/fuses etc

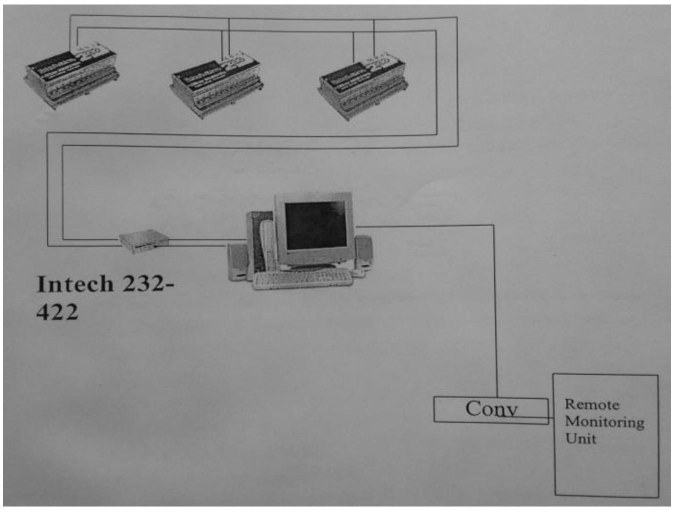

Figure.2. *Block diagram of battery monitoring unit using SCADA*

3.2. INTECH Analogue Module

- 16 Universal analog inputs
- Each inputs individually selected and scaled
- 16 bit resolution
- Differential inputs for T/C, mV. V, mA
- Thermocouples-B,E,K,J,N,R,S,T
- Two digital isolated relay outputs
- RS232/RS485 up to 1200m
- RS232 cost effective PC or PLC AI expansion
- Selected baud rates
- Programmable station numbers
- Programmable relay states
- Universal AC/DC power supply
- Easy install

3.3.2100-A16 TXE AND TX Delay settings

The TXE and TX delay are software selectable in the micro scan outstation programming box. These delays are used for RS485/RS232 operation, to control the behaviour of the transmitter on the outstation, when it is ready to send data. The TXE delay controls how long the transmitter waits before turning on. The TX delay controls how long the transmitter waits before sending data. If the TXE delay is zero. The transmitter turns on

immediately. If the TX delay is zero. The data is sent immediately, upon receiving a command.

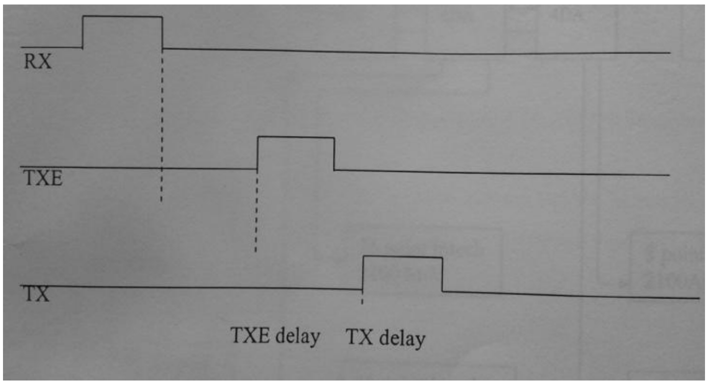

Figure.3. Intech Delay Setting.

3.4. INTECH as PLC Analogue Multiplexer or Data Logger

- Reduce PLC analog cost by 40%
- Enhance capacity of smaller PLC CPU's
- Universal:-16 individually configurable inputs
- 16 bit resolution mV, mA,V,RTD,Thermocouple
- 0.1% accuracy, all differential inputs
- 2 analog outputs,2 relay outputs
- 4 digital inputs,24v DC as strobe signal
- Connects to PLC through analog output or through serial port RS422/RS485

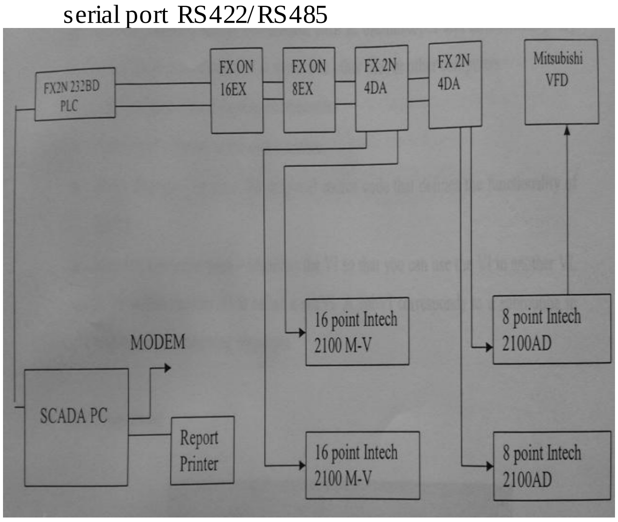

Figure.4. Intech as analog multiplexer

4. SCADA In Battery Monitoring Unit

SCADA is developed using national instruments,

Lab view is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text based programming languages where instructions determine program execution, Lab view uses data flow programming, where the flow of data determines execution. Lab view programs are called virtual instruments or vis., because their appearance and operation imitate physical instruments, such as oscilloscopes and millimetres. Every VI uses functions that information or more it to other files or other computers.

A VI contains the following components:-

- Front panel- serves as the user interface
- Block diagram- contains the graphical source code that defines the functionally of the VI.
- Icon and connector pane-Identifies the VI so that you can use the VI in another VI, a VI within another VI is called a sub VI. A sub VI corresponds to a subroutine in text based programming language.

4.1. Front Panel

The front panel is the user interface of the VI. Above figure shows an example of a front panel. You build the front panel with controls and indicators, which are the interactive inputs and outputs terminals of the VI, respectively. Controls are knobs, push buttons, dials and other input devices. Indicators are graphs, LEDs and other displays. Control simulates instruments input devices and supply data to the block diagram of the VI.Indicators simulate instruments output devices and display data that block diagram acquires or generates.

4.1.1 Block Diagram

After building the front panel, a code is added using graphical representations of the functions to control the front panel objects. The diagram contains this graphical source code. Front panel objects appear as terminals on the block diagram.

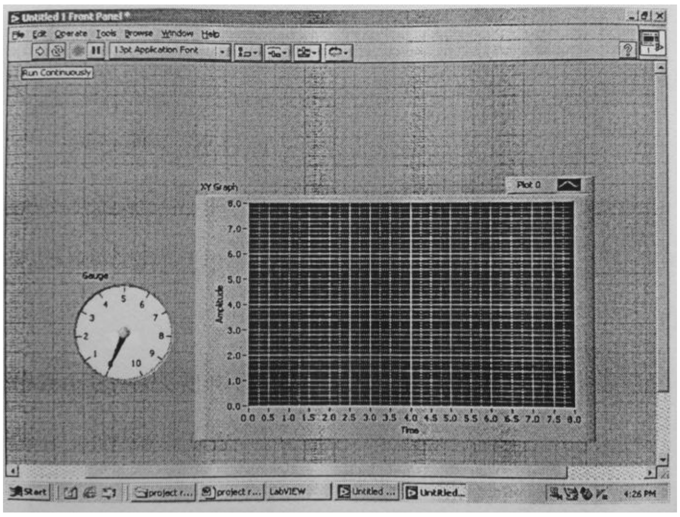

Figure.5:-Front Panel

The Lab view graphical development platform provides:-

- Intuitive graphical programming language designed for engineers and scientists.
- Interactive application specific development tools and libraries.
- Hundreds of built in functions for I/O control, analysis and data presentations
- Deployment to desktop

<u>Communication between Lab view and Intech analogue module using Active X DLL developed in VB:-</u>

- Communication using Active X:-

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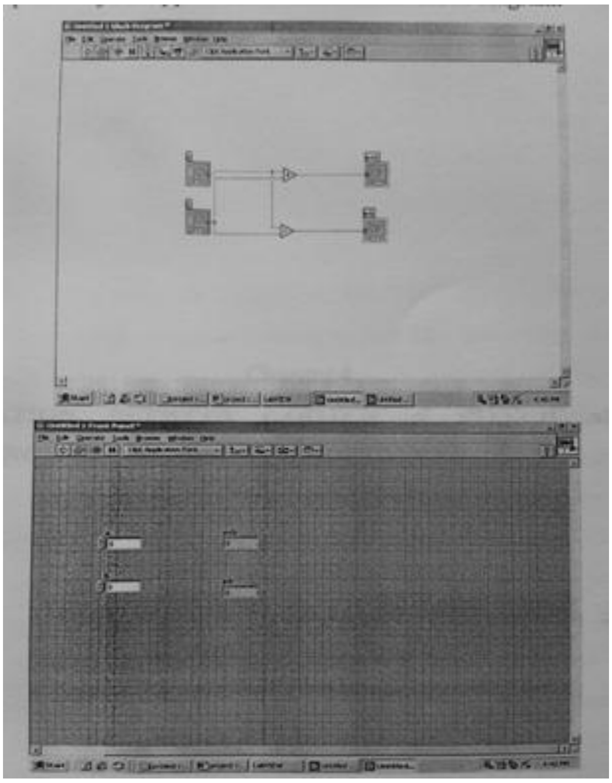

Figure.6.-Block diagram and front panel

This communication is used to communicate Intech analog module with Lab view.

- Using Active X components in VB
- Intech has its own protocol

Frame structure of Intech

4.1.2 Concept of Intech

Active X is the general name for a set of Microsoft technologies that allows users to reuse code and link individual programs together to suit their computing needs. Based on component object model (COM) technologies. ActiveX was originally developed as an extension of previous technologies called object linking and embedding (OLE) in order to facilitate the development requirements of internet based applications.

Active X Automation:-

Active X automation refers to the process of controlling one program from another via ActiveX. Much like networking, one program acts as the client and the other acts as the server. Both programs (client and server) exist independent of each other, but they are able to share information .To share information the automation client communicate with Active X objects that the automation server exposes.

The interface for an Active X server consists of the following hierarchical, object oriented categories:-

- Object:-An object is a service that an Active X server makes available to clients.
- Class:-A class is like a data type definition except that it applies to object rather than variables.
- Method:-A method performs an operation or function on an object.
- Property:- A property stores & maintains a setting or attribute object

5. INTECH Protocol Message format:-

2100-16 ASCII communication messages.

	Start character
:	End of message frame
<SP>	Data separator
<CR>	End of message indicator
NN	Station number
YY	BCC check sum value

Table.1.Message format

- Start character = @
- Station number = NN
- Message contains (command)
- End of message marker (:)
- Bcc 2 digit hex number giving check sum of message.

6. Result & Discussion

- Screens developed in SCADA:-

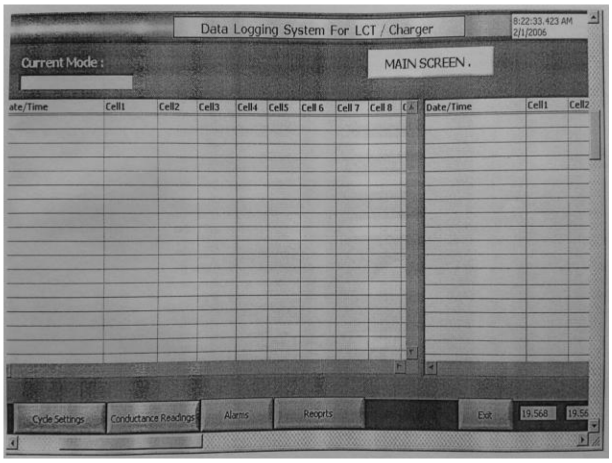

Figure.7 .Main Screen

Main screen shows the actual reading of each cell voltage & temperature as well as string voltage for both modes i.e. float mode & partial discharge mode using two tables. Current mode shows the currently working made. Clicking on my menu will take to the respective screen, whose details follow,

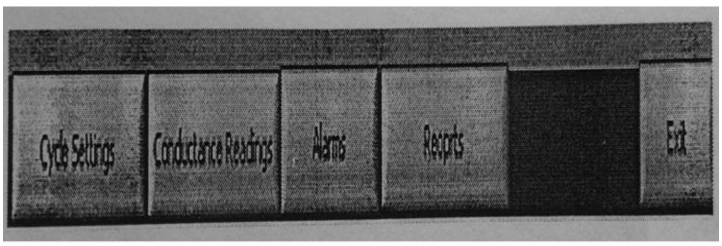

Figure.8.Menus

6.1. Cycle Settings

Before starting any cycle, cycle settings are done. Above settings include, Battery bank ID number, battery AH capacity, power plant ID,total float mode cycle duration, sampling time for float mode, total partial discharge mode duration and sampling time for partial discharge mode

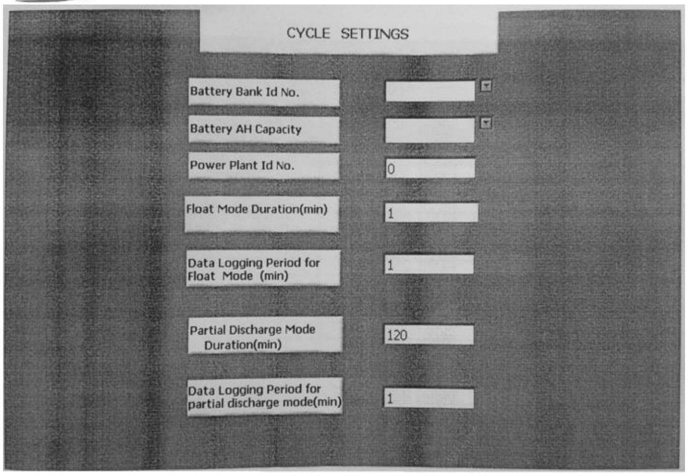

Figure.9.Cycle Setting

6.2. Reporting

Clicking on reporting will display the above screen. To see the report of required year, select that year and click on OK.Then another report screen will appear.

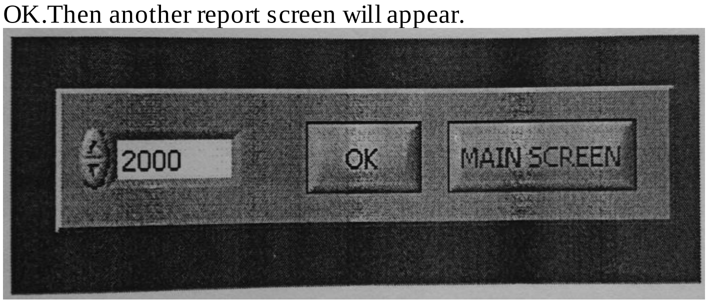

Figure.10.Reporting

6.3. Report Screen

On this screen, left table shows the summery files i.e. the files created in selected year. Clicking on any of the file will display the details of that file in the table which is at the right side.

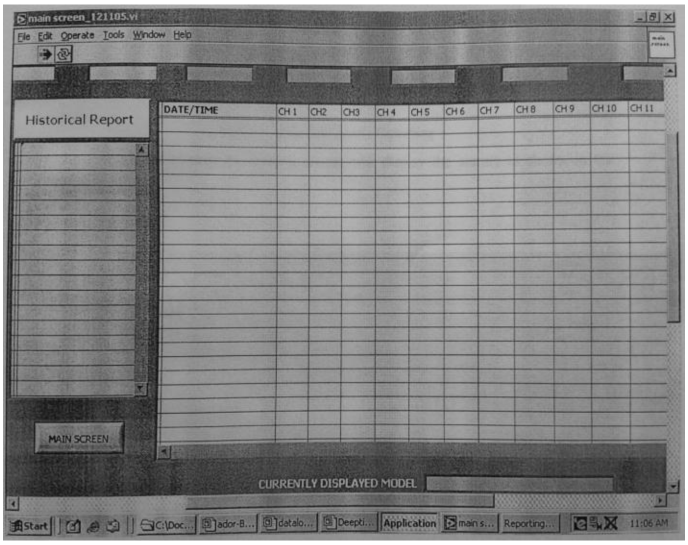

Figure.11. Report Screen

- The above blocks indicate the set parameters for the selected cycle.

- The block titled 'currently displayed model' displays the file selected from summary file table

Alarm Reporting

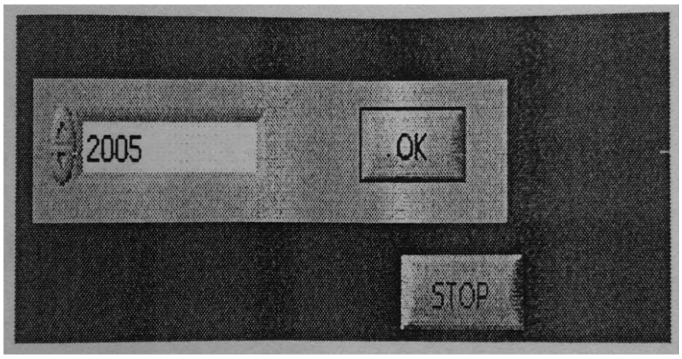

Figure.12. Alarm Reporting

- Selecting year & by clicking on OK, will display the alarms as shown in the following screen.
-

6.4. Channel Configuration for Intech A16

Intech 1:-
CH 1-6:- cell to cell 6voltages
CH 7-14:-cell temperatures
CH 15:-string voltage
CH 16:-Trickle current

- Intech 2:-
  CH 1-6:- cell 7 to cell 12 voltages
  CH 7-16:-cell temperatures
- Intech 3:-
  CH 1-12:-cell 12 to cell 24 voltages
  CH 13-16:-cell temperatures

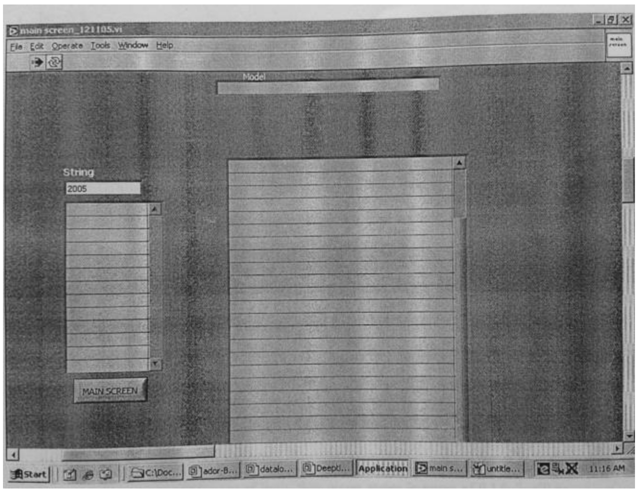

Figure.13.Alarm Reports

6.5. Reporting & Alarms in SCADA

Data files generated

- A yearly folder is created. This folder contains the files according to year, month & day wise files. Also it contains the files for respective conductance readings.
- Each file has the details of the cell voltages, temperatures & the files for conductance

Calculated for each cell with respect to entered sampling time

6.5.1. Alarms

- Here, the monitoring parameters are sent to Remote Monitoring Unit (RMU) is sending alarm limits applicable to cell voltages.

If any reading appears to be out of limit, then alarm status in terms of 0.1&2 will be sent to the RMU.If actual value is less then value 2 will be sent to RMU.If actual value is more, then value 1 will be sent to RMU & if actual value is within range, then value 0 will be sent to RMU.

- All the monitoring parameters will be sent to the monitoring table in Microsoft database access. Alarm status will also be sent to alarm urgent table in Microsoft access database. Then communication protocol developed in Visual Basic will send this data to RMU as per demand.

Control parameters i.e. alarm limits will be picked up by LABVIEW, SCADA from control table which is in Microsoft database access & these limits will be sent by RMU

6.5.2. Communication & Cable Details

Intech A16 to Intech NS 2100 232-485 Converter

Aten Converter	**Intech A16**
TX+	**RX+(71)**
TX-	**RX-(70)**
RX+	**TX+(73)**
RX-	**TX-(72)**

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